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Cultural and fertilizer studies with sweet potatoes, muskmelons and watermelons on Buckner coarse sand

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Cultural and Fertilizer Studies With Sweet Potatoes, Muskmelons and Watermelons on Buckner Coarse Sand

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CONTENTS

SUMMARY

Experimental work reported herein was done in the Muscatine Island district on Buckner coarse sand.

A. EXPERIMENTS WITH SWEET POTATOES

1. A comparison of plant spacings in the row of 15, 21 and 28 inches in rows 3.5 feet apart showed the 15-inch spacing produced the most U. S. No. 1 sweet potatoes per acre, although the yield per hill was reduced by the closer spacings under conditions of a perfect stand of plants.
2. A complete commercial fertilizer, 3-9-18, at the rate of 500 pounds per acre, produced yields of U. S. No. 1 sweet potatoes equal to those produced by 750 or 1,000 pounds of the same fertilizer at three different plant spacings.
3. A comparison of yields produced by planting on three dates—May 13, May 20 and May 28—showed that the May 20 planting produced the highest yields of sweet potatoes in 1940 and 1941, but the May 28 planting was highest in yield in 1942, because of cutworm damage to the two earlier plantings.
4. There was no difference in yield of sweet potatoes produced by nitrate of soda, ammonium sulfate, uramon or cyanamid, used as the nitrogen fertilizer, in a complete fertilizer analysis 3-9-18.
5. Various fertilizers used in the transplanting water commonly called "starter" solutions, 1938-1942 inclusive, failed to increase the yields of sweet potatoes.
6. Applying fertilizer in liquid form to the growing crop as side dressing did not increase yields of sweet potatoes over the dry form applied as side dressing. When applications were delayed too long, a reduction in yield occurred.
7. Under conditions where green manures were used in the rotation for sweet potatoes, time of application of commercial fertilizer did not influence yield. Fertilizer

applied before planting or as a side dressing after planting at 3-, 4- and 6-week intervals gave equally good results.

8. The yield response of sweet potatoes to manure and to manure-commercial fertilizer combinations varied in different growing seasons. In 1941, 10 tons of barnyard manure plus 340 pounds of commercial fertilizer produced a greater yield than did other treatments, but in 1940 and 1942 commercial fertilizer alone produced satisfactory yields without manure. Manure alone, in 1941, increased yields over one commercial fertilizer treatment, but where manure is scarce, satisfactory yields can be obtained with commercial fertilizer.

9. When overhead sprinkler irrigation was used, growing sweet potatoes on a ridge did not affect yield as compared to growing them on the level.

10. Tests of nitrogen, phosphate and potash alone and in various combinations for 3 years for sweet potatoes, indicated the need for high potash, relatively high phosphate and medium nitrogen applications to this soil.

B. EXPERIMENTS WITH MUSKMELONS

1. More early muskmelons were produced by the early planting, May 5, than by the two later plantings, May 18 and June 2, but the total yield and the date of the last picking did not differ significantly for the three planting dates.

2. The delayed application of 250 pounds per acre of commercial fertilizer to muskmelons produced greater yields than did the application of 8 tons of manure per acre.

C. EXPERIMENTS WITH WATERMELONS

1. In 1941 manure in combination with a delayed application of a commercial fertilizer, increased the yield in comparison with manure alone. In 1942 there was no significant difference in yield between manure alone and commercial fertilizer in combination with manure.

Cultural and Fertilizer Studies With Sweet Potatoes, Muskmelons and Watermelons on Buckner Coarse Sand[1]

By V. E. Hollar and E. S. Haber

The sandy soils of the Buckner series in Muscatine and Louisa Counties are used mainly for vegetable crops. Yields of sweet potatoes, muskmelons and watermelons are good in favorable seasons. Sandy soils suitable for sweet potato production are present in other parts of Iowa, but those north of Muscatine County are too far north for maximum production. Muskmelons and watermelons can be grown farther north, but the greatest area of commercial production in Iowa is in Muscatine and Louisa Counties.

There are about 6,700 acres of Buckner coarse sand in Muscatine County. This soil dries out rapidly, and irrigation by either furrow or overhead rotary sprinkler system is a common practice with commercial growers in this district. There are several thousand acres of fine sands and sandy loams, in addition to the Buckner coarse sand, in Muscatine, Louisa, Lee and adjacent counties. These soils are also well suited for sweet potato and melon production.

All of the experimental plots were irrigated by the overhead rotary sprinkler system. Growing these crops commercially or experimentally without irrigation in many seasons will result in total failure of the crop. The rainfall throughout the growing season is not distributed uniformly, so that there are periods when growth is so seriously checked that yields are reduced.

Irrigation water was applied in 1939 and 1940 when observations on the condition of the plants and the soil indicated its need. In 1941 and 1942, the Bouyoucos-Mick Wheatstone Bridge and gypsum block method of determining soil moisture was used along with observations to determine when irrigation water should be applied.

[1] Projects 301 and 693 of the Iowa Agricultural Experiment Station.

TESTS WITH SWEET POTATOES

THE EFFECT OF PLANT-SPACE AND FERTILIZER-RATE ON YIELDS OF SWEET POTATOES FOR 1939-1942, INCLUSIVE

Three spacings of plants in the row were used: 15-inch, 21-inch, and 28-inch. The distance between rows was 3.5 feet. Three rates of application of fertilizers were used: 500, 750 and 1,000 pounds per acre. The following fertilizers were used: 2-14-14 in 1939, 3-12-12 in 1940 and 3-9-18 in 1941 and 1942. The change in fertilizer formula in 1941 was the result of fertilizer experiments which showed the need for more potash for this crop.

A variety of the Yellow Jersey group was used each year, and all combinations of plant-space and fertilizer rate were included in the field plots. In table 1, yields of U. S. grade No. 1 sweet potatoes per acre are given for each treatment. Yields of "seconds" and culls are not given since usually there is no sale for these grades.

TABLE 1. YIELD FROM VARIOUS SPACE-RATE COMBINATIONS.*

Space between plants	Fertilizer in lbs. per acre	Yield of U. S. grade No. 1 per acre				
		1939	1940	1941	1942	4-yr. average
15 inches	500	115	213	136	176	160
15 inches	750	133	224	135	186	170
15 inches	1000	125	211	127	203	167
21 inches	500	106	195	109	159	142
21 inches	750	119	191	128	195	158
21 inches	1000	109	177	140	181	152
28 inches	500	108	187	114	153	141
28 inches	750	101	183	114	140	135
28 inches	1000	115	177	116	149	139

* The experimental design used was a 3x3 factorial with 3 replications. Each plot contained approximately 1/20 acre.

There were no significant differences in yield from any of the space-rate combinations. When all plant spacings were averaged and the fertilizer-rate effect considered, it was found that 500 pounds per acre produced yields equal to those produced by 750 or 1,000 pounds of fertilizer. Earlier work indicated that less than 500 pounds were insufficient. The results are presented in table 2.

The advantage of closer spacing was shown when all fertilizer rates were averaged. Each year a higher yield of No. 1 potatoes was obtained from the closer spacings. Over a 4-year period the 21-inch space produced an average of 13 bushels

TABLE 2. YIELD PRODUCED BY THREE FERTILIZER RATES; AVERAGE OF ALL PLANT SPACINGS.

Per acre fertilizer rate (Av. of all plant spacings)	No. 1 yield in bushels per acre				
	1939	1940	1941	1942	4-yr. average
500 pounds	110	198	120	163	148
750 pounds	118	199	126	174	154
1000 pounds	116	188	128	178	153

per acre more than the 28-inch space, and the 15-inch space produced 14 more bushels per acre than the 21-inch space. The 4-year average yields given in table 3 differ significantly.

The number of plants per acre required for the three spacings is given in table 3. The cost of plants will vary with the season and the individual grower. No attempt was made to determine the relative economy of plant spacings, but since the growers produce their own plants the cost is relatively cheap, and since the plants are planted with a transplanting machine, very little more labor is involved.

TABLE 3. YIELD PRODUCED BY THREE PLANT SPACINGS; AVERAGE OF ALL FERTILIZER RATES.

Space between plants	Yield in No. 1 bushels per acre					Plants per acre required
	1939	1940	1941	1942	4-yr. average	
15 inches	124	216	133	188	165	9956
21 inches	111	188	126	178	151	7111
28 inches	108	182	115	147	138	5334

Significant difference for 4-year average at 5% level=11.16.

THE EFFECT OF SPACING ON THE YIELDS OF INDIVIDUAL SWEET POTATO PLANTS

Damage from stem rot, cutworms, wireworms and wind makes it impossible to have a perfect stand of plants at harvest time in the area under discussion. The effect that competition between plants at different spacings had on yields of individual plants was determined in the following manner.

The potatoes from 90 hills from each of three spacings, 15-inch, 21-inch and 28-inch, were individually weighed to determine the actual effect of competition on the yield of No. 1 size potatoes. Only those hills having complete competition on all sides were weighed.

The individual hills of the 21-inch-spaced plants yielded slightly over one-half pound more No. 1 sized potatoes than

did the 15-inch-spaced plants, and the 28-inch spacing gave an average yield of almost one-fourth pound more than the 21-inch spacing. The gain in each case was highly significant.

TABLE 4. YIELD PER HILL AT THREE SPACINGS: 1942.

Space between plants	No. 1 lbs. per hill	Theoretical bu. per acre(No.1)	Actual No. bu. per acre(No.1)	Percent of theoretical obtained
15 inches	1.50	299	188†	63
21 inches	2.09*	297	178†	60
28 inches	2.31*	247	147	60

* Significant difference at 1% level=15.66.
† Significant difference at 1% level=28.56.

The theoretical number of bushels per acre in table 4 is the yield that would have been obtained from a 100-percent stand of plants having the average hill-weight shown. The actual yield in 1942 divided by the theoretical yield is the percent of theoretical obtained. Approximately 40 percent of the potential yield was lost in 1942 because of loss in stand of plants irrespective of planting distance. Under these conditions, in 1942, the actual yield for the three-plant spacings shows a highly significant increase for 21-inch spacing as compared to 28-inch spacing. The increased yield obtained from the 15-inch spacing over the 21-inch spacing was not significant in 1942, but it should be remembered that it was significant over the 4-year period (table 3).

The increase in yield over the 4-year period, in the close spacing, was probably made possible by the general loss of plants from all spacings. This loss of plants is common in this district, because of the general prevalence of stem-rot and the damage done by insects; so that the 15-inch spacing produces larger yields of No. 1 potatoes per acre under these conditions than either of the wider spacings. In Mississippi, according to Anderson, et al,[2] using the Triumph variety, spacing of plants from 12 to 18 inches is profitable, if the plants are plentiful and cheap and if facilities are available for machine transplanting and applying fertilizer in the same operation.

[2] Anderson, W. S., Currey, E. A., Ferris, E. B., Robert, J. C. Sweet potato plant spacing. Miss. Agr. Exp. Sta., Bul. 358. 1941.

EFFECT OF PLANTING DATE ON YIELDS OF SWEET POTATOES

It is customary to make more than "one pulling" of plants or "slips" from sweet potato roots in the hotbed for transplanting. At the "first pulling" slips of sufficient size are taken for transplanting. Small slips continue to grow and attain sufficient size for later transplanting to the field. The following experiment was conducted to determine the optimum planting date within the range commonly used in the Muscatine area.

Three planting dates were chosen, May 13, May 20 and May 28. These are designated in the text as early, medium and late, respectively, since practically all of the planting in southeastern Iowa occurs during the period included. Earlier planting dates were not used, since the sweet potato plant is highly susceptible to frost damage and injurious frosts may occur previous to the "early" date selected. Plants used in the test were not from "first pulling" from the hotbed in every case but were of the same size in each treatment. Time of pulling of plants is not considered as having any effect on yield, according to the work of Beattie, Boswell and McCown[3] who showed no difference in yield produced by first, second or third pulling of plants. Likewise they found May 15 the best planting date at Florence, S. C.

TABLE 5. YIELD OF SWEET POTATOES FROM THREE PLANTING DATES, 1940-1942, INCLUSIVE.*

Planting time	No. 1 yield in bushels		
	1940	1941	1942
Early: May 13	86	219	96
Medium: May 20	114†	242†	111
Late: May 28	96	211	143†

* Complete randomized blocks with six replications of each planting date. A variety of the Yellow Jersey group was used.

† Highly significant compared to other yields in the same year.

Results show that May 20 was the optimum planting date in 1940 and 1941, and May 28 in 1942. As the Muscatine, Iowa, district is approximately 8 degrees of latitude north of Florence, S. C., it is to be expected that the optimum planting

[3] Beattie, J. H., Boswell, Victor R. and McCown, J. D. Sweet potato propagation and transplanting studies. U. S. D. A. Circ. 502. 1938.

time would be a little later. In 1942 the May 28, or late planting, gave a significantly greater yield than the two earlier plantings, but this was probably influenced by the stand of plants, since the stand of plants in the plots of the two earlier plantings was noticeably reduced by cutworms, whereas the stand in the late planting was not as seriously reduced. Early plantings are damaged by cutworms more than the later plantings even though poison bran mash is used for control.

SWEET POTATOES; NITROGEN CARRIER FERTILIZER TEST

The purpose of this experiment was to determine the relative value of various nitrogen fertilizers, used with superphosphate and potassium chloride to make up a complete fertilizer. The fertilizer formula was 3-12-12 in 1939 and 1940 and 3-9-18 in 1941 and 1942. The change to a higher potash ratio and slightly lowered phosphate ratio was based on the results of earlier work which showed the 3-9-18 to be a better fertilizer for sweet potatoes on these soils. The variety used each year was of the Little Stem Jersey group. The check treatment received 0-9-18 at the same rate, 600 pounds per acre.

TABLE 6. SWEET POTATO YIELDS WITH FOUR NITROGEN CARRIERS.*

Nitrogen carrier	No. 1 yield in bushels per acre				
	1939	1940	1941	1942	Average
Nitrate of soda	116	108	111	140†	119
Ammonium sulfate	116	107	106	160‡	122
Uramon	118	92	112	151‡	118
Cyanamid	106	81	122	§	103
No nitrogen (check)	91	125	116	116	112

* The experimental design was a 5x5 Latin square.
† Significant over-check.
‡ Highly significant over-check.
§ Not available. Cyanamid was not available for general agricultural purposes in 1942 because of its use in war industry.

No significant differences in yields as influenced by the various nitrogen carriers were shown for the 3-year average or for any one year; but in 1942, 3 percent nitrogen in the fertilizer formula, irrespective of source, gave an average increase in yield of 34 bushels per acre over the check. In other years, however, the response to nitrogen has not been consistent. Failure of nitrogen applications to increase yields in 3 out of 4 years does not indicate that nitrogen would not be

beneficial when legumes are not included in the rotation. On these plots cowpeas turned under as green manure every second or third year have been a part of the rotation.

STARTER SOLUTIONS APPLIED TO SWEET POTATO TRANSPLANTS

Several investigators have reported beneficial results from the use of fertilizer in the water applied by the transplanter during the transplanting operation. The term "starter solution" has been applied to the material used in this practice. Sayre[4] in New York concluded that a small amount of readily available fertilizer in solution poured around tomato roots when transplanted to the field proved very effective in stimulating earlier growth and increasing yields. Ammo-Phos (11-48-0) alone or in combination with nitrate of potash (13-0-44) or a mixture of di-ammonium phosphate and monopotassium phosphate proved the most satisfactory.

Stair and Hartman[5] in Indiana found starter solutions applied to tomato plants on transplanting increased early yields but not the total yields for the whole season. Baker[6] obtained greater yields of early and late tomatoes on soils relatively low in available phosphorus, when phosphoric acid and soluble phosphate were applied at transplanting time.

Since the Buckner coarse sand is relatively low in available nutrients, it was thought that benefits might result from the use of starter solutions on sweet potato transplants. The practice has consistently failed to increase yields during the past 5 years. The following fertilizers have been used:

1. Season 1938 and 1939: nitrate of soda, 2 pounds per 50 gallons of water.
2. Season 1940: tri-ammonium phosphate, 1 and 2 pounds per 50 gallons of water.
3. Season 1941: ammonium phosphate (11-48-0), 2 and 4 pounds per 50 gallons of water.

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4 Sayre, Charles B. Nutrient or starter solutions and vitamin B for transplanting tomatoes. Proc. Amer. Soc. Hort. Sci., 38:489-495. 1941.

5 Stair, E. C. and Hartman, John D. The use of nutrient solutions in the transplanting water for tomato plants 1939. Proc. Amer. Soc. Hort. Sci., 37:913-915. 1940.

6 Baker, C. Edward. Early fruiting of tomatoes as induced by the use of soluble phosphate. Proc. Amer. Soc. Hort. Sci., 35:668-672. 1937.

4. Season 1941 and 1942: 6-27-9, 2 and 6 pounds per 50 gallons of water.
5. Season 1942: 3-9-18, 2 and 4 pounds per 50 gallons of water.
6. Season 1942: 10-52-17 (completely water soluble form), 3 pounds per 50 gallons of water.

A variety of the Yellow Jersey group was used each year. Plots were replicated, and all treatments were checked against water alone in the transplanter barrel.

Although the foliage was a darker green during the early part of the growing season where starter solutions containing high nitrogen were used, no differences in yield resulted at harvest. Stands of plants were not noticeably increased by the use of starter solutions. Although starter solutions are relatively cheap to apply, if no increase in yield results, there is no need for this added cost of production.

APPLICATION OF FERTILIZER IN LIQUID FORM FOR SWEET POTATOES

In New Jersey, Tiedjens and Schermerhorn[7] reported exceptional increases in yields of vegetables grown in sandy loam by the application of fertilizer in liquid form during the growing season. The reason for applying fertilizer in water was to make the plant nutrients immediately available to the plant. Plant response could be obtained in dry weather when dry fertilizer has little effect.

Three separate experiments with a water solution of fertilizer for sweet potatoes on Buckner coarse sand were made in 1942. Preliminary tests on a small scale were made in 1941 and well-replicated field plot designs were used in 1942. Results for 1941 are not presented, as significant increases were not obtained in comparing the liquid and dry form of application. All tests were made with Yellow Jersey group varieties.

In the first test, both the dry form and the liquid form of fertilizer were applied as side dressings and checked against the customary practice of applying dry fertilizer in the furrow before planting. The fertilizer applied was 3-9-18 at the rate of 600 pounds per acre in the dry form, and 600 gallons per

[7] Tiedjens, V. A. and Schermerhorn, L. G. Growing vegetables with fertilizer in water. New Jersey Agr. Exp. Sta., Bul. 694. 1942.

TABLE 7. YIELD OF SWEET POTATOES WITH LIQUID AND DRY FERTILIZER APPLICATIONS IN 1942.

Fertilizer*	U. S. No. 1 yield in bushels per acre
Liquid form, applied one-half at 4 weeks and one-half at 7 weeks after planting	140
Liquid form, applied at 4 weeks after planting	131
(Check) Dry form applied before planting	130
Dry form, applied one-half at 4 weeks and one-half at 7 weeks after planting	124
Dry form applied 4 weeks after planting	111

* Five replications of each treatment in randomized blocks.

acre in the liquid form. The liquid fertilizer was prepared by dissolving 1 pound of fertilizer in 1 gallon of water.

Although the differences in table 7 are large and seem to favor the liquid application, they are not statistically significant because of large variations between replications within the same treatment.

The second test of liquid fertilizer was designed to check the time of application of the liquid along with two different rates of application. Treatments and yields are presented in table 8.

TABLE 8. YIELD OF SWEET POTATOES FOLLOWING APPLICATION OF LIQUID FERTILIZER AT DIFFERENT RATES AND TIMES IN 1942.

	Fertilizer per acre*	U. S. No. 1 yield in bushels per acre
1.	Liquid form at the rate of 800 pounds of dry fertilizer. Applied one-half at 4 weeks and one-half at 7 weeks after planting	195†
2.	Same as above but only 600 pounds	177†
3.	600 pounds in dry form. Applied before planting	173†
4.	Liquid form at the rate of 600 pounds of dry fertilizer, applied one-half at 4 weeks and one-half at 12 weeks after planting	143

* The fertilizer used was 3-9-18 in each treatment. The liquid form was made by adding 1 pound of fertilizer to each gallon of water. Four replications of each treatment in a 4x4 Latin square were used.

† Significantly greater than treatment No. 4.

In table 8 it can be seen that there was no significant difference between the yields produced by the 600-pound rate and the 800-pound rate; neither was there a significant difference between yields produced by applications 4 and 7 weeks from planting as compared to application before planting.

The application of fertilizer in liquid form when applied

one-half at 4 and one-half at 12 weeks after planting resulted in the least yield of any of the treatments. Since the split applications made one-half at 4 and one-half at 7 weeks after planting produced the highest yield, these data indicate that part of the fertilizer may be applied as late as 7 weeks after transplanting, but if application is delayed as long as 12 weeks, yield will be reduced.

In the third liquid fertilizer trial, fertilizer application was divided into three equal quantities applied at 4, 7 and 8 weeks after transplanting, and compared to application of all the fertilizer at 1 month. The check consisted of application of the fertilizer in dry form at 1 month after planting.

TABLE 9. YIELDS OF SWEET POTATOES WITH LIQUID AND DRY FERTILIZERS APPLIED AT VARIOUS TIMES IN 1942.

Fertilizer*	U. S. No. 1 yield in bushels per acre
Liquid form applied in three equal applications at 4, 7 and 8 weeks after transplanting	71
Liquid form. All applied 1 month after transplanting	71
Dry form. All applied 1 month after transplanting	80

* The fertilizer used was 3-9-18 in each treatment. The liquid form was made by adding 1 pound of fertilizer for each gallon of water. Four replications of each treatment were made.

This test gives further indication that the liquid form has no advantage over the dry form of fertilizer, and that split applications do not increase yield as compared to single applications. The differences between yields in table 9 are not significant.

RESULTS WITH VARIOUS DATES OF APPLICATION OF DRY FERTILIZER TO SWEET POTATOES

The general practice in applying commercial fertilizer to sweet potatoes is to place the fertilizer in the furrow 1 to 3 weeks prior to planting. This experiment was designed to find whether any damage to plants resulted from application of fertilizer closer to transplanting time, as well as to determine the effect of delayed fertilization.

A uniform application of 600 pounds of 3-9-18 fertilizer per acre was made 7 days before planting, 4 days before planting, 5 weeks after planting, 4 weeks after planting and 6 weeks after planting. In the last three treatments, fertilizers were

TABLE 10. YIELD OF SWEET POTATOES WITH FERTILIZER APPLIED BEFORE AND AFTER PLANTING IN 1942.*

Fertilizing time	U. S. No. 1 yield in bushels per acre
7 days before planting	112
4 days before planting	108
3 weeks after planting	117
4 weeks after planting	125
6 weeks after planting	119

* A variety of the Yellow Jersey group was used in this experiment. Yields given are the average of five replications planted in a 5x5 Latin square.

applied as a side-dressing after the plants were transplanted. Results are presented in table 10.

The plots which had no fertilizer until 6 weeks after planting were showing starvation symptoms, relatively short vines and light green to yellow leaves within 5 weeks after transplanting. Regardless of the early starvation of these plots, they produced yields equal to those of the plots in any of the other treatments. There were no significant differences in yields between treatments. Fertilizer applied in the furrow a week before planting produced no more than side-dress applications of the same fertilizer 3, 4 or 6 weeks later.

THE USE OF BARNYARD MANURE AS A FERTILIZER FOR SWEET POTATOES

Manure is scarce in the Muscatine Island District, as few vegetable growers have livestock, but some growers ship in manure for this soil. The following tests were made to determine the value of manure as a sweet potato fertilizer.

Several combinations of fertilizers with manure were tried and several rates of application were made. Changes were made in treatments from year to year.

TABLE 11. YIELDS OF SWEET POTATOES WITH VARIOUS RATES AND COMBINATIONS OF ORGANIC AND INORGANIC FERTILIZERS.*

Fertilizer per acre	U. S. No. 1 bushels per acre			
	1939	1940	1941	1942
700 pounds 6-9-18	140	113	199	
700 pounds 3-9-18		113	235	150
10 tons barnyard manure alone	127			154
15 tons barnyard manure alone		102	245	
4 tons turkey manure alone	115			
5 tons barnyard manure plus 400 pounds 0-9-18	134			
10 tons barnyard manure plus 100 pounds 0-20-0				142
10 tons barnyard manure plus 340 pounds 0-9-18		101	245	144
10 tons barnyard manure plus 340 pounds 3-9-18		108	261	150

* In this experiment a variety of the Yellow Jersey group was used each year. The design used was a Latin square. All fertilizer was applied before planting.

The results of this experiment show that the use of one particular fertilizer combination may produce relatively high yields in one year and relatively low yields in another. Seven hundred pounds of 6-9-18 gave a highly significant increase over other treatments in 1939, and the lowest yield in 1941. Fairly good yields resulted from the use of 3-9-18 each year it was used. Five to 10 tons of manure supplemented by commercial fertilizers produced good yields in all years. In 1940 and 1942 there were no significant differences between yields produced by the different fertilizers used. In 1939, 6-9-18 gave the highest yield of all treatments, and in 1941, 10 tons of manure plus 340 pounds of 3-9-18 gave the highest yield. In only 1 year out of 4 was there a significant increase in yield due to the use of manure, and this only when in combination with commercial fertilizer. Satisfactory yields can be obtained with commercial fertilizer.

LEVEL CULTIVATION AND RIDGE CULTIVATION AND THEIR EFFECT ON SWEET POTATO YIELD IN 1942

Sweet potato producers in this area transplant on a ridge, and maintain this ridge by cultivation methods. High ridges are necessary where the furrow method of irrigation is used. Some of the growers now use the overhead rotary sprinkler type of irigation but still use the ridge method of cultivation. The method of preparing the soil was the same for both treatments in this experiment; the usual method of applying commercial fertilizer before planting was followed, and the variety used was of the Yellow Jersey group.

On Buckner coarse sand, which is very well drained, it was found that the ridge was not necessary where the overhead system of irrigation was used. No difficulty was encountered in cultivation or in harvesting, and yields on level cultivated plots were the same as those of adjacent plots in which the ridge had been maintained by continuously throwing the soil toward the row during each cultivation.

TESTS OF COMMERCIAL FERTILIZERS FOR SWEET POTATOES, 1939-1941, INCLUSIVE

A great many comparisons between various fertilizer combinations might be made from table 12, but for practical pur-

TABLE 12. THE YIELD OF SWEET POTATOES WITH 26 DIFFERENT FERTILIZER COMBINATIONS, 1939 TO 1941, INCLUSIVE.*

Commercial fertilizer analysis	U. S. grade No. 1 bu. per acre	Commercial fertilizer analysis	U. S. grade No. 1 bu. per acre
3-12-18	134.71	3-0-18	102.79
3-6-18	128.85	3-0-9	96.35
6-6-18	118.47	0-0-9	95.20
6-12-9	116.53	3-12-0	92.99
6-0-18	115.47	0-12-0	92.91
0-6-9	114.64	0-12-18	91.93
0-0-18	113.95	6-6-0	90.76
0-12-9	112.49	3-6-0	89.03
6-12-18	111.73	6-12-0	81.10
3-12-9	109.82	0-0-0	70.02
3-6-9	108.74	6-0-0	68.47
6-6-9	107.95	0-6-0	67.33
0-6-18	107.93	3-0-0	64.66
6-0-9	106.16		

Significant difference at 5% level, 18.66; at 1% level, 24.87.

* The variety used in this experiment was of the Yellow Jersey group. A 3x3x3 factorial design with two replications was used. All fertilizers were applied at the rate of 750 pounds per acre.

poses the selection of the most economical analysis is all that will be attempted here. The use of 6 percent nitrogen alone or in a complete fertilizer did not increase yields over those secured when 3 percent nitrogen was used. Fertilizers containing 12 percent phosphate alone or in combination did not significantly increase yields over those containing 6 percent phosphate. Complete fertilizers containing potash at the 18 percent level were, in most cases, superior to those containing the 9 percent level. In general, a fertilizer containing nitrogen, phosphorus and potash is superior to any one of these alone and in most cases superior to combinations of any two of them. A 3-6-18 fertilizer will be satisfactory according to this test, but a 3-9-18 conforms in general to the standard of 30 units of plant food, and can be purchased readily since it is a standard analysis with fertilizer manufacturers.

TESTS WITH MUSKMELONS

MUSKMELONS: YIELDS AS INFLUENCED BY TIME OF PLANTING

The usual planting season for muskmelons in the Muscatine district extends from May 1 to May 8. A test was made to determine the effect of a later planting, since replanting is frequently necessary following frost injury and cutworm damage common to early plantings. Stand, ripening date and yields are given in table 13.

The May 5 planting and the May 18 planting gave almost

TABLE 13. YIELDS AND WEIGHTS OF MUSKMELONS AT THREE DATES OF PLANTING, 1942.*

Planting date	Stand on Sept. 1	Av. yield in bu. per acre	Av. weight per melon
May 5	69%	157	2.63 lbs.
May 18	70%	156	2.66 lbs.
June 2	96%	173	2.41 lbs.

* The variety used was Hales Best. The design was randomized blocks having three replications. Manure was used at the rate of 5 tons per acre on all plots.

identical stand, yield and size of melons. The greater percentage stand obtained from the June 2 planting was due to the absence of insect and frost injury, which occurred on the two earlier plantings. A consideration of yield, stand or melon size is not usually as important as the dates of ripening in the Muscatine district. Figure 1 shows the three dates of planting and the percentage of melons harvested on given dates throughout the season.

The percentage of melons ripening during the first 10 days or 2 weeks of August is of great importance, because the price

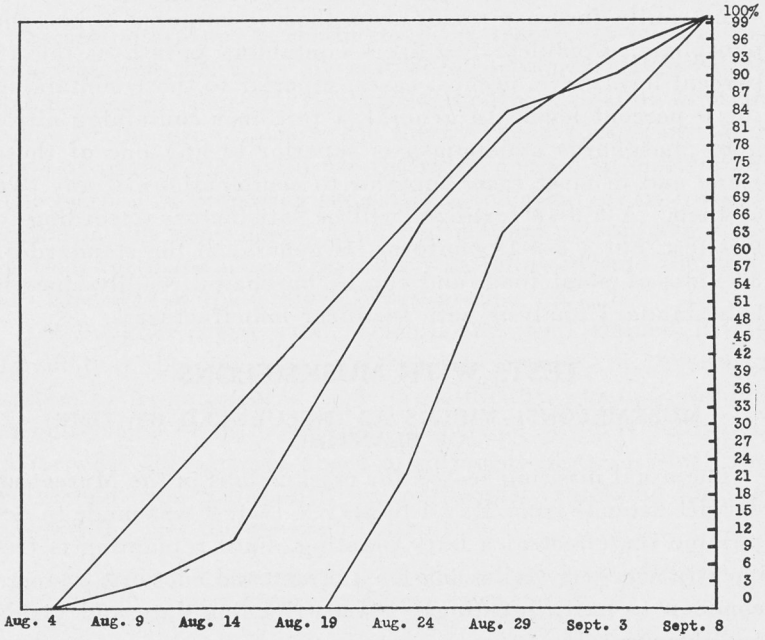

Fig. 1. Percentage of total yield of muskmelons ripe on given dates at three times of planting in 1942.

is usually highest during this period. The May 5 planting ripened 18 percent of its crop by Aug. 9 and 33 percent by Aug. 14; while the May 18 planting ripened only 3 percent and 10 percent, respectively, by the same dates. The May 5 planting gave a more uniform rate of harvest, while both of the later plantings, May 18 and June 2, ripened a larger percentage of their yield in a short time. The harvest of the late planting, June 2, was of especially short duration. The bulk of its yield ripened between Aug. 24 and Sept. 3, a period of very low prices in normal years. May 5 was the most desirable planting date tested in 1942 because of higher prices for earlier melons.

MUSKMELON YIELDS AS AFFECTED BY COMMERCIAL FERTILIZERS AND MANURE

The general practice in growing muskmelons in the Muscatine district is to apply from 5 to 8 tons of manure in the furrow before listing-in to prepare the ridge on which the planting is made. Some growers apply commercial fertilizer as a later side-dressing in addition to the manure. The purpose of this experiment was to determine whether commercial fertilizer, in addition to manure, produced an increase in yield, and to determine the effect of commercial fertilizer alone, and manure alone, on yield.

The commercial fertilizers used, 10-6-4 and 4-8-8, each at the rate of 250 pounds per acre, produced significantly higher yields than did 8 tons per acre of manure. The manure was applied in the furrow before planting, and the commercial fertilizers were side-dressed 7 weeks after planting unless otherwise designated. When 10-6-4 was applied in the furrow before planting, it did not increase yields over manure alone. Manure plus 125 pounds per acre of 4-8-8, side-dressed 7 weeks after planting, also failed to increase yields over the manure alone. These results were obtained where a crop of fall-sown rye was listed into the furrow in the spring, as is the general practice on these sandy soils. Under these conditions the addition of more organic matter in the form of manure did not produce yields as great as those produced by 250 pounds per acre of either 10-6-4 or 4-8-8 when these commercial fertilizers were applied with the cultivator about the time

of the last cultivation, after runners were beginning to start from the plant.

TABLE 14. YIELD AND WEIGHT OF MUSKMELONS WITH MANURE, COMPLETE COMMERCIAL FERTILIZER ALONE AND IN COMBINATION.*

Fertilizer per acre	Yield in 50 lb. bu. per acre	Average weight per melon
250 pounds 10-6-4 applied 7 weeks after planting (No manure)	131†	2.35 lbs.
250 pounds 4-8-8 applied as above (No manure)	123†	2.28 lbs.
8 tons barnyard manure plus 125 pounds 4-8-8 side-dressed 7 weeks after planting	108	2.59 lbs.
500 pounds 10-6-4 applied before planting (No manure)	95	2.32 lbs.
8 tons manure only (check)	86	2.49 lbs.

Significant difference at 5% level=29.87 lbs.
* The Hales Best variety was used. Four replications of each treatment were planted in randomized blocks.
† Significantly greater than check.

TESTS WITH WATERMELONS

WATERMELON FERTILIZER TESTS

The general practice in fertilizing watermelons in Iowa is to use approximately 5 tons of manure per acre (one fork full per hill) placed in the furrow before planting. In this experiment, manure has been used as the check and various amounts of commercial fertilizers used alone and in combination with manure.

In 1941 all plots were fertilized at the rate of 5 tons of manure per acre. One-half of the plots received an additional application of 250 pounds per acre of either 4-12-4 or 4-8-8, 6 weeks after planting. The fertilizer was placed around each hill, taking care not to place it on the vine itself. The plots receiving manure and fertilizer gave an average increase in yield of 45 percent over the plots receiving manure alone.

TABLE 15. YIELDS OF WATERMELONS WITH MANURE AND COMMERCIAL FERTILIZERS IN 1941.*

Fertilizer per acre	Yield in tons per acre
5 tons fresh manure plus 250 pounds 4-12-4 side-dressed by hand 6 weeks after planting	5.83†
5 tons fresh manure plus 250 pounds 4-8-8 side-dressed by hand 6 weeks after planting	5.73†
5 tons fresh manure	3.96
5 tons rotted manure	3.91

Significant difference at 5% level=1.41 tons.
* Variety Kleckley Sweet No. 6. Four replications of each treatment were planted in randomized blocks.
† Significantly greater than manure alone.

In 1942 this experiment was changed slightly. Instead of all treatments receiving a base application of 5 tons of manure per acre, one-half of the treatments received only commercial fertilizer. The purpose of the change was to determine the effect of commercial fertilizer alone, as well as in combination with manure. Manure alone was also included in the experiment, as were different methods of applying the commercial fertilizer. Table 16 lists the treatments and the average yields obtained.

TABLE 16. YIELDS OF WATERMELONS WITH MANURE AND COMMERCIAL FERTILIZERS IN 1942.*

Fertilizer per acre	Yield in tons per acre
5 tons manure plus 150 pounds 4-12-4 side-dressed by machine at time of last cultivation	7.87
5 tons manure plus 250 pounds 0-12-12 in the furrow before planting	7.76
300 pounds 4-12-4 alone. Side-dressed by hand 7 weeks after planting	7.41
300 pounds 4-12-4 alone. Side dressed by machine at time of last cultivation	7.30
300 pounds 4-12-4 top dressed 7 weeks after time of planting	7.19
5 tons rotted manure alone (check)	6.61

* Six replications of each treatment were made in a 6x6 Latin square design. Variety used was the Dixie Hybrid.

In 1942 the manure plus 4-12-4 as a side-dressing was again high in yield, although the differences were not significant. The important thing shown in this experiment is that commercial fertilizer alone, and in relatively small quantities, produced yields equal to those produced by plots receiving manure alone or manure supplemented by commercial fertilizers. There was no difference in yield produced by commercial fertilizer applied by hand as compared to application with a cultivator side-dresser.

The use of commercial fertilizer alone greatly simplifies the culture of watermelons, as the fertilizer may be applied either by hand or with a cultivator having a fertilizer attachment. When manure must be purchased, hauled in, and spread by hand the total cost would undoubtedly be higher than the cost of obtaining and applying 300 pounds of commercial fertilizer. The cost of applying commercial fertilizer is negligible when it is applied with a cultivator, at a time when cultivation would have been necessary anyway.

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